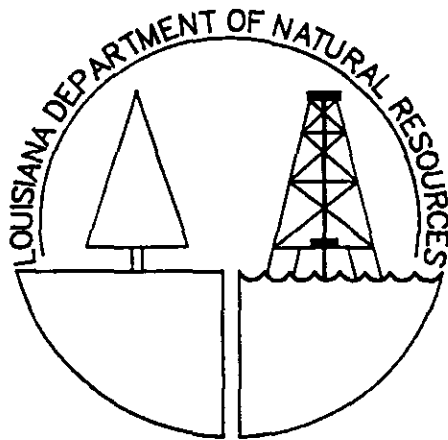


Louisiana Department of Natural Resources



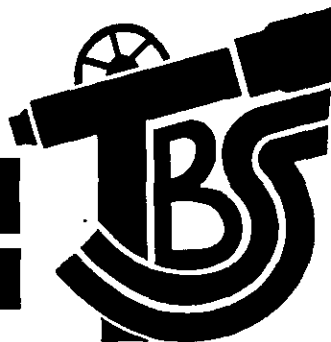
Barrier Island Plan

DNR Contract No. 25081-95-02

Phase 1 - Step I

Formulation of Strategic Options Final Report

April 14, 1998



T. BAKER SMITH & SON, INC.

Established 1913

ENGINEERING • SURVEYING • ENVIRONMENTAL
PROFESSIONAL SERVICES

Barrier Island Plan

Phase 1 - Step I Report

Formulation of Strategic Options

April 13, 1998

**T. Baker Smith & Son, Inc.
DNR Contract No. 25081-95-02**

PROJECT OVERVIEW

The barrier island plan is authorized by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The purpose of this study is to determine whether the Louisiana barrier shoreline provides significant protection to Louisiana's coastal resources. If the study proves that the barrier shoreline provides these significant benefits, then this study will develop the most cost effective method to maximize those benefits.

The three year barrier island feasibility study is divided into three phases based on geographical location. Phase 1 is located between the Atchafalaya and Mississippi Rivers. Phase 2 encompasses the cheniere plain barrier formations in Vermilion and Cameron Parishes. Phase 3 focuses on the Chandeleur Islands. Phase 1 is the area currently being studied.

The project is structured to reach an implementation plan by starting from a broad descriptive analysis and gradually becoming more site-specific and detailed as the steps proceed.

Each resource study or island option plan begins with some type of qualitative assessment and progresses to a more detailed quantitative analysis. For example: Step C will qualitatively focus on the status and trends of resources for the broad study area; whereas, Steps E and F will quantitatively assess and inventory the existing environmental and economic resources respectively. Also, Step I is a general evaluation of the needs and problems in the study area and development of management alternatives. Later, Step L will define the preferred plan criteria and choose a recommended implementation plan from the management alternatives developed in Step I, based on the quantitative assessments made in Steps J and K.

The first report completed for the barrier island feasibility study is Step A, which reviews prior studies, reports, and existing projects that pertain to the study's purpose, scope, and area. Step A also identifies and describes existing and potential barrier island and wetland restoration projects that affect the Phase 1 area. Step A is an overall orientation for the team on the project area. The literature review ensures that the team is knowledgeable and familiar with the most current literature available on the barrier islands and is using the most up-to-date information throughout the overall study.

Step B is also completed and contains a conceptual and quantitative framework for the barrier island study. The conceptual framework describes the functions and processes affected by barrier islands and the potential impacts on the significant resources in the study area. The significant resources include economic, cultural, recreational, and land-use resources. Step B also contains a review of the available methods for quantitatively predicting the effects of the barrier islands on environmental and economic resources. This information outlines the general study area for the team and describes the methodology that will be used in Step G to forecast physical and hydrological changes.

Step C provides qualitative assessments of the status and trends of the resources in the project area. A general study area map from Step B defines the area influenced by the barrier islands for the purposes of the Step C general resource assessment. These assessments include economic, social, cultural, water, biological, recreational, and land resources. In addition, the climatology, hydrology, and geological processes are analyzed with regard to their status and trends within the study area. Historical land losses are documented, as well as natural and human

contributors to barrier island and wetland change. This information is gathered to demonstrate the characteristics of the study area and to show the resources at risk due to the loss of the barrier shoreline. It also orientates the team to the area and ensures the team will consider these resources in later steps.

Step D is a quantitative inventory of the physical parameters that are used to forecast changes in the economic and environmental resources. Step D involves delineating zones of environmental and economic analysis in the general study area described in Step B. The zones are designated using the Hurricane Andrew storm surge as criteria. The physical process parameters (waves, wind, sea level, sediment transport, etc.) and the geomorphic parameters (surficial sediments, topography, bathymetry) are identified, including data sources, type and quality of data, and any inconsistencies or "gaps" in the data. This information will be used as input for the modeling and forecasting effort in Step G. The results of Step D allow the team to evaluate the proposed modeling effort as outlined in Step B.

Step E provides a quantitative inventory and assessment of existing environmental resource conditions, with an emphasis on those resources considered significant. The team developed the criteria for determining "significant" environmental resources. Wildlife habitats, breeding grounds, and endangered species refuges are among those resources that have been assessed. Step E includes historical habitat/wetland change maps and describes the land loss rates and their associated changes. These data will be used to forecast the impact of the no-action scenario for environmental resources.

Step F is a quantitative inventory and assessment of existing economic resource conditions. This includes all structures, facilities, farmland acreage, and public resources (roads, channels, bridges, etc.) that are susceptible to the consequences of wetland/land loss, shoreline erosion, or hurricane induced flooding. The value of these economic resources and their residual worth will be included in the assessment. Historical damage and losses caused or induced by oil spills, waves, wetland/land loss, and shoreline erosion will also be evaluated. These data will be used to forecast the impact of the no-action alternative on economic resources.

The forecasted trends of physical and hydrological conditions are discussed in Step G. A 30 and 100 year forecast of the present and future physical conditions was modeled, showing the effects of a no-action scenario. The study was conducted using the methods described in the Step B report and the data specified in the Step D report. Bathymetry and topography, waves, tides, storm surge, and other factors that affect the economic and environmental resources were forecasted.

The effects on environmental and economic resource conditions will be forecasted in Step H. Projected wetland/land loss will be presented for the 30 and 100 year no-action scenario. This will estimate, through the modeling results from Step G and projected trends, the total land loss and the effects on the wildlife and economic resources in the Phase 1 study area that may be experienced in the future as present conditions proceed. At the completion of Step H, the team will have amassed information detailing the projected changes in the barrier shoreline and the anticipated effects of those changes on the environmental and economic resources in the area. The team can then use this information as a baseline for comparing other alternatives.

In Step I, the team identified and evaluated the strategic options. This process will proceed through Steps J, K, L, and M. The later steps involve the identification and explanation of the preferred alternative(s). Step I involved identifying the problems, needs, and opportunities of the study area and developing strategic options. Options were considered on an island-chain spatial scale. These options included: restoring a historical island configuration, establishing a fall back line, no-action alternative, preserving present-island configurations, strategic retreat, and other possible options. A general assessment of engineering, environmental, economic, and social factors regarding strategic option implementation were considered. Arrays were developed comparing the different options with these factors. Those options that cannot be implemented because of long-term effects, or other conditions, were no longer considered. The remaining options became management alternatives and will be analyzed in greater detail in Step J. Step I provides the necessary island size and inlet locations for the modeling study in Step J.

Step J is the assessment of management alternatives. The most important input for Step J is the identification of the specific management alternatives found in the Step I report. Step J includes qualitative and quantitative assessment of the management alternatives. This step includes a more detailed analysis of the effects of the proposed management alternatives on the environmental and economical resources of the area. For example, if a management alternative being investigated in Step J is a 1930 island configuration, then in Step J the increased flood protection potential from hurricanes by virtue of the size increase of the barrier islands will be described. That protection estimate will be an approximate dollar estimate and not a general assessment as was done in Step I. The output for Step J will be a detailed assessment of the effects of the management alternatives on the resources in the area. Resources include environmental, economical, and social. Where possible, the effects on resources will be quantified. The report should be based on a thirty year projection into the future and compared to the *no action scenario*.

Step K involves identifying and assessing possible management and engineering techniques for the management alternatives developed in Step I. Step K assesses the engineering techniques that may be used to implement the management alternatives identified in Step I. The long-term impacts will be used to assess the effectiveness of the various engineering and management techniques. This step will determine possible use of beach fill, coastal structures, and possible regulatory controls that will provide optimal design life and cost effectiveness. Output from these methods will predict maintenance quantity and frequency. Dune crest height and berm and beach slopes will be determined for limiting wave runup and overtopping. Volumes of beach fill will be calculated after the beach and dune configurations are established. In addition, borrow site identification and assessment will be completed. This will determine the cost, quantity available, and methodology for using various borrow sites for material if needed. The output for Step K will be the general applicability, cost, and impacts of various engineering alternatives.

Step L will be a description of the rationale for selecting a preferred plan. The criteria will be based upon the detailed assessments made in Steps J and K to develop a cost/benefit relationship. Step J will supply the benefits for each management alternative, while Step K details the cost. The selected management alternative and associated engineering and management techniques will be developed to form preliminary plans and cost estimates. Included will be all beach fill and coastal works concepts, sources of material, and cost of maintenance and monitoring.

In Step M, the team will select the preferred plan based on the criteria described in Step L. The team will then describe the methodology for instituting permitting, right-of-way/construction agreements, final engineering design, bidding, construction, mitigation, monitoring and maintenance. The preferred island configuration will be presented with potential structures, beach fill, dune restoration, and protection plans. Preferred sand sources and the effect of removing the sand will also be detailed. The Step M report will outline time, cost, and regulatory parameters.

Step N is a consolidation of all deliverables into one final report document. This final report will summarize the information provided in all previous documents.

FOREWORD

The purpose of this study is to assess and quantify wetland loss problems linked to protection provided by the barrier shoreline system along the Louisiana coast. The study will identify potential solutions to these problems, provide an economic evaluation, and determine the barrier configuration which will best protect Louisiana's coastal resources from wind/wave activity, saltwater intrusion, and oil spills.

In order to accomplish the desired goals and objectives, the study team, thus far, has completed the following steps of the study:

Phase 1 - Step A - A Review of Pertinent Literature

Phase 1 - Step B - Conceptual and Quantitative System Framework

Phase 1 - Step C - Assessment of Resource Status and Trends

Phase 1 - Step D - Quantitative Inventory and Assessment of Physical Conditions and Parameters

Phase 1 - Step E - Inventory and Assessment of Existing Environmental Resource Conditions

Phase 1 - Step F - Inventory and Assessment of Existing Economic Resource Conditions

Phase 1 - Step G - Forecasted Trends in Physical and Hydrological Conditions

This Phase 1 Step I Report is focused on Formulation and Assessment of Strategic Options for Barrier Island restoration. As a first task, the problem needs, and opportunities are evaluated for all the significant resources in the Study Area. Based on this information, an array of initial strategic options was developed. These strategic options are subsequently assessed and management alternatives are developed for further analysis in later steps.

The following is the list of personnel who have contributed to this part of the study:

T. Baker Smith & Son, Inc.

Wm. Clifford Smith, P.E., P.L.S.

Marc J. Rogers, Sr., P.E.

Stephen C. Smith, J.D.

Stephen A. Gilbreath, M.S.

Donald W. Davis, Ph.D.

Coastal Engineering and Environmental Consultants, Inc.

Oneil P. Malbrough, Jr., REM

Subrata Bandyopadhyay, Ph.D.

Murali M. Dronamraju, Ph.D., MBA

Applied Technology Research Corporation

Lawrence S. McKenzie, III, M.S.

Lorna Guynn

Louisiana State University

Mark R. Byrnes, Ph.D.

Randolph A. McBride, M.S.

Denise J. Reed, Ph.D.

Gregory W. Stone, Ph.D.

Joseph N. Suhayda, Ph.D.

Bruce A. Thompson, Ph.D.

TABLE OF CONTENTS

	Page
PROJECT OVERVIEW	i
FOREWORD.....	v
LIST OF FIGURES	ix
LIST OF TABLES	x
 1.0 INTRODUCTION.....	 1
 2.0 PROBLEMS, NEEDS AND OPPORTUNITIES	 4
2.1 Environmental Resources	5
2.1.1 Problems	5
2.1.2 Needs.....	7
2.1.3 Opportunities.....	8
2.2 Socio-Economic Resources	8
2.2.1 Problems	8
2.2.2 Needs.....	9
2.2.3 Opportunities.....	9
2.3 Engineering Resources.....	10
2.3.1 Problems	10
2.3.2 Needs.....	12
2.3.3 Opportunities.....	12
 3.0 FORMULATION OF STRATEGIC OPTIONS	 13
 4.0 EVALUATION OF STRATEGIC OPTIONS	 21
4.1 Definition of the Sub-Areas	21
4.1.1 Sub-Area 1: Isle Dernieres Chain	21
4.1.2 Sub-Area 2: Timbalier Chain.....	22
4.1.3 Sub-Area 3: Caminada-Moreau Headland.....	22
4.1.4 Sub-Area 4: Plaquemines Shoreline	22
4.2 Definition of the Resources	24
4.3 Evaluation Methodology.....	25
4.4 Evaluation of Environmental Resources.....	26
4.4.1 No Action	26
4.4.2 Strategic Retreat.....	27
4.4.3 Fall-Back Option.....	27
4.4.4 Preserve Pre-Hurricane Andrew Configuration	29
4.4.5 Historic Configuration	29
4.5 Evaluation of Social Resources	31
4.5.1 No Action.....	32

	Page
4.5.2 Strategic Retreat.....	32
4.5.3 Fall-Back Line	32
4.5.4 Existing Configuration.....	33
4.5.5 Historic Configuration	34
4.6 Evaluation of Economic Resources	36
4.6.1 No-Action	37
4.6.2 Strategic Retreat.....	37
4.6.3 Fall-Back Line	37
4.6.4 Existing Configuration.....	38
4.6.5 Historic Configuration	38
4.7 Evaluation of Engineering Parameters.....	41
4.7.1 No-Action	42
4.7.2 Strategic Retreat.....	43
4.7.3 Fall-Back Line	43
4.7.4 Existing Configuration.....	45
4.7.5 Historic Configuration	47
4.8 Summary of Evaluation Results.....	51
5.0 FORMULATION OF MANAGEMENT ALTERNATIVES	53
5.1 Evaluation of the Preferred Options.....	53
5.2 Development of Alternatives	54
5.2.1 Alternative 1.....	55
5.2.2 Alternative 2.....	58
6.0 SUMMARY	60
7.0 REFERENCES.....	63

LIST OF FIGURES

	Page
Figure 1. Methodology and Decision Making Process.	3
Figure 2. Barrier Island Restoration Plan - Strategic Option Three	16
Figure 3. Barrier Island Restoration Plan - Strategic Option Four.....	18
Figure 4. Barrier Island Restoration Plan - Strategic Option Five	20
Figure 5. Definition of Sub-Areas	23
Figure 6. Preferred Alternative One	57
Figure 7. Preferred Alternative Two	59

LIST OF TABLES

	Page
Table 1. Environmental Resources.	30
Table 2. Social Resources.	35
Table 3. Economic Resources.	40
Table 4. Engineering Parameters.	50
Table 5. Summary of Evaluation Results.....	52

1.0. INTRODUCTION

The purpose of the Step I report is to list the problems, needs, and opportunities associated with barrier islands, define and *qualitatively* evaluate strategic options, and develop management alternatives to protect coastal resources in the Phase 1 Study Area. The alternatives developed in this step will be analyzed further in future steps, resulting in a preferred barrier shoreline plan for the Barrier Shoreline Feasibility Study. Figure 1 illustrates the methodology and decision-making process used in the Step I analysis.

Initially, the problems, needs, and opportunities associated with barrier shoreline deterioration are identified. For the purposes of this analysis, they are separated into social, economic, environmental, and engineering resources. Problems include the detrimental effects to coastal resources caused by physical processes associated with losing the barrier islands. Needs are deficiencies in the resources that may be improved through barrier shoreline restoration. Opportunities are “favorable” conditions that may be used to achieve the objective of protecting coastal resources through barrier shoreline restoration. The problems, needs, and opportunities are used to then develop a methodology for evaluating the strategic options.

Second, the strategic options are defined. The strategic options defined in this report are drawn from the Barrier Shoreline Feasibility Study (BSFS) Request for Proposals (#25081-95-02). A strategic option is a broad engineering concept of potential island configurations or, in the case of strategic retreat, a management concept. The descriptions of the strategic options in the Request for Proposals were vague and required further definition to facilitate analysis by the team.

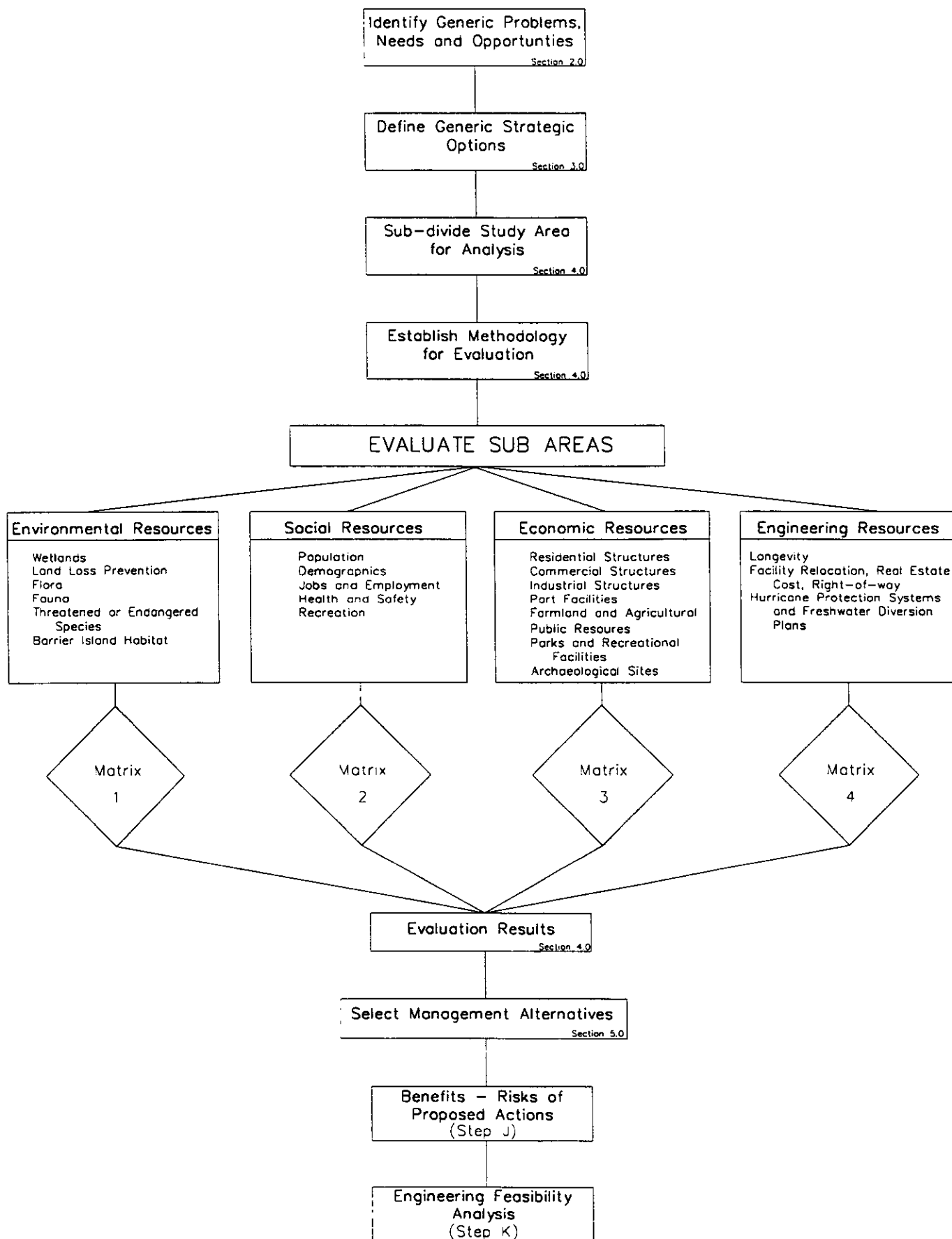
After the strategic options are defined, the evaluation methodology is developed. The evaluation methodology is based on the resource benefits each strategic option provides. The resource benefits are categorized into social, environmental, economic, and engineering. The benefits are assessed using evaluation criteria based on the problems, needs, and opportunities developed earlier.

The Phase 1 Study Area is then divided into four sub-areas: Isles Dernieres, Timbalier Island, Caminada-Moreau Headland, and Plaquemines Shoreline. Evaluating the options at a sub-area scale facilitates a more localized analysis that offers more flexibility in development of management alternatives.

Next, the strategic options are assessed using the evaluation methodology previously described for each of the sub-areas. Evaluating the options indicated which options were best suited to protect coastal resources in each of the sub-areas. The options in each sub-area are chosen individually, based on their overall benefits, for each coastal resource (economic, environmental, social, and engineering).

Finally, the results of the evaluation for each sub-area and by each resource are combined to develop the management alternatives. The alternatives are then refined to ensure that all relative needs have been satisfied. Once refined, the management alternatives are ready for detailed analysis in later steps of the Barrier Shoreline Feasibility Study.

Figure 1. Methodology and Decision Making Process



2.0. PROBLEMS, NEEDS AND OPPORTUNITIES

This section describes the problems, needs and opportunities associated with the Phase 1 barrier shoreline. The exercise of identifying the problems, needs, and opportunities associated with the Phase 1 barrier shoreline serves several purposes. The result of this exercise should be a study team that is focused on the unique aspects of the system and uses this understanding to propose the best overall solution. Identifying problems ensures that the study is focused on the aspects of the system which are most important. Problem definition concentrates the team's efforts on those aspects that truly require remediative efforts. This is a more refined investigation relative to the problem determination made prior to the study initiation. Problem definition leads to needs identification. Needs are identified and used to evaluate proposed solutions. Solutions that address some or all of the needs should be given great consideration. Opportunities are situations or conditions favorable in attaining the goal of protecting coastal resources and should contribute to the solution of a problem and/or address a need.

Louisiana's beaches and barrier islands act as buffers for coastal marshes and communities, absorbing much of the wave action from the Gulf of Mexico (USACE 1984; BSFS Step G Report). These barrier islands also play a major role in determining the basin hydrology, the socio-economic prosperity and cultural diversity of southern Louisiana, and help maintain the diversity of plants and animal life in the unique ecosystem of the coastal wetlands.

Continued deterioration of these islands thus threatens the resources of coastal Louisiana that are impacted directly or indirectly by the presence or absence of barrier islands. Continued retreat of these islands will eventually expose valuable marshes to direct attack from the Gulf. Loss of these marshes would have a severe impact on existing coastal development and fish and wildlife resources important to the State and Nation (USACE 1984).

For the purpose of defining the specific problems, needs, and opportunities the resources in the Study Area have been summarized under four major groups:

- Environmental (wetlands, fish and wildlife, etc.);
- Economic (oil production and infrastructure, commercial fisheries, etc.);
- Social (recreation, demographic patterns, etc.); and
- Engineering (flood protection systems, freshwater diversions).

Economic and social resources are discussed together as "Socio-Economic Resources" due to their interdependency.

2.1. ENVIRONMENTAL RESOURCES

2.1.1. Problems

Barrier islands separate the Gulf from bays and sounds. Without barrier islands, these bays and sounds would become more like shallow, near-shore Gulf waters that have a different species assemblage. Tidal inlets are the conduit for tidal energy and salinity regimes within the bay systems. They also shelter bay shorelines from offshore waves generated in the Gulf of Mexico (BSFS Step G Report). Many of the economically important species harvested in Louisiana are taken from the larger bays where they occur as sub-adults. Other species spend their adult life in the larger bays or in the near-shore Gulf. Species adapted for living in the surf zone are dependent on barrier island habitats for their life-cycle (Louisiana Coastal Wetlands Task Force 1993).

Barrier islands provide valuable habitat for fish and macroinvertebrates in four zones: open surf-zone beach, back island low-energy flats, island marshes, and intra-island ponds and streams. These are nursery habitats for many migratory fishes and macroinvertebrates. They provide essential habitat for resident estuarine species that may spend their entire life cycle in barrier island habitats. The island ponds

and streams are particularly important as spawning and feeding areas for these resident species. In addition, the shallow areas around the islands are used by many adult fish as feeding stations. Many of these habitats are eroding rapidly and will disappear completely if no restoration efforts are initiated in the near future.

The deterioration of barrier islands is also causing diminishing habitat for macrocrustaceans. Foraging species (i.e., Croaker, Anchovy, etc.) and commercially important macrocrustaceans are facing diminishing habitat. Thompson (1988) provided species lists for the fish found in the Isle Dernieres. The pattern of loss of these habitats will be similar to Timbalier Island if no action is taken to rebuild these habitats.

Barrier islands provide functional habitats for various species of shorebirds, wading birds, and other avian species. Continued erosion of these islands will result in an increasing loss of functional habitats for these birds. Breeding, nesting, feeding and resting areas for seabirds, shorebirds and for brown pelicans, herons and associated species, which depend upon both the sand beach and dunes and the marsh/mangrove habitat, will ultimately cease to exist with the complete erosion of these islands. The barrier islands also provide vital stopover habitats for long-distance migratory songbirds. Continued erosion of these islands will have an adverse impact on these birds.

In comparison with the Isle Dernieres and Timbalier Island chains, the existence of habitat for birds would be more long-lived in Grand Isle since this island is more stable. However, erosion, although at a slower rate, does continue to alter Grand Isle habitats and poses a potential threat of losing these habitats completely from this island. Due to the erosion of barrier islands, the aerial spread of vegetated land (dunes and maritime forest) is also diminishing.

Diminishing barrier island area leads to greater wave activity in the coastal bays behind the islands. This will lead to greater wave energy impacting interior marsh shorelines and will increase the suspended sediment load in the waters moved into the coastal marshes during southerly winds (Reed 1989). The

increase in turbidity may negatively impact fisheries species that rely on water clarity for feeding as well as the growth of submerged aquatic vegetation (SAV) in marsh ponds. This SAV provides good refuge habitat for juvenile fish and macrocrustaceans and will be threatened by increased turbidity and decreased light penetration.

Shoreline erosion around coastal bays accounted for 10% of land loss in the Mississippi Delta Plain between the 1930's and 1990 (Penland *et al.* 1996). Loss of barrier island habitat will further increase wave attack on the marshes marginal to the bays and may increase the contribution of bay shoreline erosion to overall wetland loss. The deteriorated nature of the marshes immediately behind the marsh-bay shoreline means that as fragmented islands, which now border the bays, are eroded away, the bay shoreline retreats across existing open water to the next intact marsh area. This means that on a scale of decades, the bays expand much faster than the actual rate of marsh erosion at any site.

2.1.2. Needs

The primary need associated with environmental resources is to provide sustainable habitat for various biological species by retaining the integrity of the barrier islands and protecting coastal wetlands from shoreline erosion.

Maintenance of a sustainable habitat on the barrier islands is contingent upon the integrity of the barrier islands. At present, sediment supply to the barrier system is minimal and is critical to sustain the islands. There is a need to introduce sediment into the system to combat subsidence and eustatic sea level rise. There is also a need to protect and enhance the fish and wildlife resources in the estuaries by keeping the barrier shoreline between the Gulf and the bays. There is a need to provide more nearshore habitat for commercial and recreational significant species. There is also a need to provide more nesting habitat for threatened and endangered species that use the barrier islands.

2.1.3. Opportunities

The opportunities to fulfill the needs of coastal Louisiana are two-fold; protection of the existing habitat and creation of sustainable new habitats. For both protection and creation of habitat, the availability of sediment is most critical. Adding beach width and constructing dunes would provide more nesting areas. Tidal wetlands on the bayside of the barrier islands would provide habitat for certain aquatic species. Rebuilding the barrier shoreline may reduce storm surge through reduction of inlet size and prevention of overtopping of low-lying islands. Sheltering of wave energy could reduce future bay shoreline erosion. Therefore, an opportunity exists, through barrier island restoration, to change the rate at which the bays widen under the future without project conditions.

2.2. SOCIO-ECONOMIC RESOURCES

2.2.1. Problems

Several socio-economic problems can be directly or indirectly attributed to the deterioration of Louisiana's barrier shorelines and the associated wetland loss. As barrier islands continue to erode, coastal erosion processes continue to function without the protection provided by these barriers. As the problem of land loss continues, it contributes to the migration and disruption of individuals' lives and economic activities. The current and future conditions of the barrier shoreline expose many socio-economic resources to the adverse impacts of hurricanes, deteriorating estuaries, and loss of revenue attributable to coastal resources. Within the "Zone of Economic Analysis", important commercial and industrial centers are also more vulnerable to storm-induced damages. Therefore, investment requirements in all infrastructural facilities are anticipated to increase.

It is important to understand from a socio-economic perspective that the magnitude of restoring the barrier shorelines will involve considerable expenditure of public money. This investment will equal any large-scale public works project in the country's history. It requires, therefore, a political commitment equal to the project's size. The problem's complexity crosses jurisdictional and parish boundaries thereby

complicating its solution. Public awareness and outreach initiatives need to be intensified, since local, state and national awareness concerning the socio-economic importance of barrier shorelines is often poorly understood or has never been explained.

2.2.2. Needs

There is a need to reduce the potential infrastructural damages and losses projected to be impacted by barrier shoreline erosion. Political support is required in order to alleviate the problems associated with the deteriorating barrier shorelines. Financial resources to rebuild the shorelines need to be identified and aggressively pursued. Education is considered critical. Local, state and national educational initiatives need to be implemented to inform the population about the protective role played by Louisiana's barrier shorelines.

2.2.3. Opportunities

There is a discrete set of socio-economic options that can be identified with the loss of the state's barrier shorelines. A carefully formulated management plan can minimize the impacts associated with these options. For example, eco-tourism and recreational business ventures can be increased and promoted by preserving the wetlands and restoring the barrier shorelines. In addition, available drinking and industrial water supplies can be improved and perhaps enhanced by preventing or significantly reducing saltwater intrusion. Commercial fisheries and trapping activities can be sustained by maintaining or improving aquatic habitats. Shoreline inlets can continue to provide easy access to offshore-related industries. Furthermore, diminishing the vulnerability of the "Zone of Economic Analysis" can enhance and promote new businesses, expansion of existing business ventures, development of new or expanded scientific research and training initiatives, and reduce oil and gas production and distribution facilities maintenance costs. Pipeline corridors and their associated anchor points can also be stabilized.

2.3. ENGINEERING RESOURCES

2.3.1. Problems

The engineering problems associated with the barrier islands include the instability of the gulf shoreline and the bay shoreline and frequent overwashing of the dunes. Engineering solutions to these problems are complex because of the vulnerability of the fragile coastal ecosystem to hurricanes and flooding. A properly engineered protection system should not only protect the environment and infrastructure from the adverse effects of hurricanes, but also facilitate navigation. Availability of sand to rebuild the barrier islands and maintain the barrier shoreline is an engineering challenge that needs careful consideration for short- and long-term impact.

The barrier islands along the coast of Louisiana are extremely unstable land masses which continuously migrate due to continued wind and wave action and tidal flows. Extra tropical storms and hurricanes frequently overwash these islands and cut gaps in the shoreline, thus creating a further avenue for erosion (USACE 1984). Channel construction and coastal development, as well as the natural forces of compaction, subsidence, sea level rise, winds, waves, and storm surges leave the barrier islands highly susceptible to erosion (USACE 1984).

Another engineering obstacle associated with rebuilding the barrier island is the Coastal Barrier Resource Act of 1982 (Revised as the Coastal Barrier Resource System in 1990.) In the Act, Congress acknowledged that coastal barriers along the Atlantic and Gulf coasts of the U.S., along with adjacent wetlands, marshes, estuaries, inlets and nearshore waters, provides habitat for migratory birds and other wildlife, and are essential spawning, nursery, nesting, and feeding areas for commercially and recreationally important species of finfish and shellfish. Barrier islands have significant scientific, recreational, scenic, historical, cultural, and economic importance. The barrier shoreline serves as a natural storm buffer (CBRA P.L. 97-348).

The Phase 1 barrier shoreline falls under the Coastal Barrier Resources Act (CBRA), with the exception of Grand Isle. Under CBRA, the Federal government cannot expend funds for coastal barriers within the Coastal Barrier Resource System (CBRS). However, the act allows Federal funds to be spent for projects between Bastian Bay and Chenier au Tigre to prevent erosion of, or stabilize any inlet, shoreline, or inshore areas where the purpose is not encouraging development. The purpose of the Act is to: 1) save human lives by discouraging development in hazardous areas, 2) to protect environmentally and economically valuable coastal resources, and 3) to reduce Federal expenditures and subsidies for coastal development. Also, the Act serves as a long-term conservation plan for fish, wildlife, and other natural resources by restraining development on the islands.

Coastal restoration of the barrier shoreline within the Phase 1 Study Area meets the requirements set forth in the CBRA for the following reasons:

- A project which protects any use or facility necessary for the exploration, extraction, or transportation of energy resources which can be carried out only on, in, or adjacent to coastal water areas because the use or facility requires access to the coastal water body.
- Projects for the study, management, protection and enhancement of fish and wildlife resources and habitats. This includes, but is not limited to, acquisition of fish and wildlife habitats and related lands, stabilization projects for fish and wildlife habitats, and recreational projects.
- Assistance for emergency actions essential to the saving of lives, the protection of property and public health and safety.
- Nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore natural stabilization systems.

2.3.2. Needs

There is a need to rebuild the barrier shoreline to combat existing erosion rates and prevent frequent overwash of the islands. The primary engineering need is to add sediment to the barrier shoreline and keep as much of the sand on or near the islands as possible. Also, construction of a particular alternative needs to be feasible from the standpoint of right-of-way acquisition, purchasing of real estate, and relocation of existing facilities. Barrier island restoration should maximize potential benefits provided from freshwater diversions, while also working to enhance hurricane protection benefits.

2.3.3. Opportunities

The opportunities associated with engineering aspects include rebuilding a barrier shoreline that maximizes environmental, economic, and social resource benefits. Rebuilding the islands involves heightening dunes to prevent overwash, widening the gulfside beach, and building a marsh platform on the bayside. An opportunity exists to keep material in the littoral zone if some non-navigable inlets and island breeches are closed. In addition to island restoration and periodic maintenance, opportunities exist to maintain the island using detached breakwaters, groins/jetties, revetments/seawalls, feeder berms, and dune stabilization involving vegetative planting and sand fencing.

3.0. FORMULATION OF STRATEGIC OPTIONS

In this section, the five options listed in the Barrier Shoreline Feasibility Study Request for Proposals are described in detail. The description in the Request for Proposals was too vague for the analysis required in Step I. It was necessary for the team to better define the strategic options for the Step I evaluation. These descriptions were developed in consultation with the CWPPRA agencies and the team to ensure the most reasonable definition of the proposed strategic options.

For the purposes of this step, none of these strategic options consider implementation of any hard structures, such as, groins, detached breakwaters, seawalls, etc. It is assumed that these options will include construction of soft structures using sand and sediment only in conjunction with appropriate regulatory control. The need for and utility of hard structures will be investigated in later steps. In Step I, the team did not require the level of design detail necessary to determine the use of hard structures in specific areas. Step I is focused on broader aspects of shoreline protection and its associated benefits through *qualitative* analysis/discussion.

(1) Strategic Option 1: No Action - The no action option is a projection of future conditions if no restoration effort is initiated. In this case, it has been assumed that the authorized CWPPRA projects (through 1995) will be implemented, and the long-term benefits of these projects will be credited. This option also considers the benefits of the Davis Pond Freshwater Diversion Project. Beyond these projects it is assumed that no further coastal restoration efforts will transpire.

(2) Strategic Option 2: Strategic Retreat - The concept of strategic retreat recognizes the dynamic nature of the shoreline and associated wetlands and requires humans to retreat in response to the natural processes without interfering with those processes. Therefore, the concept of strategic retreat accepts the fact that the shoreline and associated wetlands are dynamic and humans are expected to respond

accordingly. Under this option, both natural habitat and human infrastructure are allowed to migrate landward leaving space for nature to inundate and create new habitat.

(3) Strategic Option 3: Fall-Back of New Barriers - This option involves construction of a fall-back line of new barriers landward of the present coastline (Figure 2). These barriers are designed to simulate the form and function of healthy barrier islands, while providing protection closer to the inland marsh. The existing barrier islands in this option are considered to be sacrificial and are allowed to deteriorate, leaving the basin-wide fall-back barrier to function in the long-term. For this level of analysis, the fall-back barriers have been assumed to be constructed using sand and other sediments.

Leatherman (1981) observed that a 213 m wide (700 ft) barrier island is expected to provide enough width to allow overwash to compensate for shoreline losses as was shown at Assateague Island. Boyd and Penland (1981) concluded that a dune height of two meters (6.6 ft) is likely to prevent overwash from fronts and tropical storms, which occur approximately 10 to 30 times per year. Based on this information, the width of the fall-back barriers have been initially set at 200 m (656 ft) with dune heights of 2 m (6.6 ft). These barriers will be positioned in a manner that would ensure adequate exchange of water between the marsh and the bay, and would accommodate navigational requirements.

The fall-back position would take advantage of existing topographic features (e.g., mainland marshes, former barrier trends, existing ridges, distributary levees, etc.). The fall-back option would begin at Caillou Bay and continues westward along the northern edge of Lake Pelto. The barriers would follow the southern boundaries of Lake Barre and Lake Raccourci and stop at the western side of the Bayou Lafourche Headland. No feasible opportunities exist for the fall-back option in the vicinity of the Bayou Lafourche Headland and Caminada-Moreau Headland. The Bayou Lafourche Headland is an attached shoreline and hence, does not facilitate construction of a fall-back line. Grand Isle is predicted to exist for the next 100 years and hence, a fall-back barrier would be illogical in this area (Refer to Step G of the Study for details). At Barataria Pass, the fall-back option would extend northward and surrounds Barataria

Bay. At the southern portion of Bay Batiste, the fall-back barriers would follow a fault line north of Lake Grande Ecaille to Empire. All major navigation passes are left open.



(4) Strategic Option 4: Preserve the Pre-Hurricane Andrew Configuration - Preserving the pre-Hurricane Andrew configuration is an option that restores the barrier shoreline to reflect the 1988 inlet configuration, and would be restored and maintained to an average width of 375 m (1,230 ft), which was approximately the average island width throughout the Study Area in 1988 (McBride *et al.* 1992) (Figure 3). As defined, all breaches developed after 1988 will be sealed, while the inlets remaining open will be returned to their 1988 width. A dune height of two meters (6.6 ft) will be required to prevent overwash from fronts and tropical storms. Raising dune heights will reduce erosion rates by acting as a sand source during hurricanes and offering protection to backdune vegetation which stabilizes the island. Dunes also supply material to counter overwash surges for low frequency events, such as a hurricane landfall (Leatherman 1981). The increased width of the island will also provide more terrestrial habitat and will also serve as a platform on which overwashed material can accumulate.

At the Caminada-Moreau Headland, the pre-Hurricane Andrew option would restore the dunes to the 2.0 m height, while constructing a protective beach and marsh platforms. Unlike the rest of the Phase 1 Study Area, the headland would not require an overall increase in width, as there is existing marsh platform north of the area. By preserving this area, most of the effort would be in providing adequate dunes and maintaining the existing shoreline.



(5) Strategic Option 5: Historic Barrier Configuration - This option involves restoration of the barrier islands to an historic barrier configuration (Figure 4) which is equivalent to the functional configuration (not position) of the inlets of 1880, as depicted in *the USGS Shoreline Change Atlas* (McBride *et al.* 1992). The historic configuration would be built on present barrier island features. All breaches and inlets would be sealed except for major tidal inlets that were in existence in the late 1800s (i.e., Wine Island Pass, Cat Island Pass, Little Pass Timbalier, Belle Pass, Caminada Pass, Barataria Pass, Quatre Bayou Pass, Pas la Mer, Chaland Pass, Grand Bayou Pass, Fontanelle Pass, and Scofield Bayou Pass). Overall, the coastal wetlands would be fronted by a continuous barrier shoreline except for major tidal entrances. Increases to the island width will be landward from the existing shoreline position.

The historic island configuration will have a width of 600 m (1,970 ft) and a dune height of 2.7 m (8.9 ft). The 600 m (1,970 ft) width represents the approximate average width of the barrier shoreline in 1978 (McBride *et al.* 1992). This representative width achieves the goal of providing a larger island than the pre-Hurricane Andrew option, but is limited to a design width of 600 m (1,970 ft) to provide a practical configuration. A 2.7 m (8.9 ft) dune height represents the larger dune heights of some natural dunes located on the barrier islands in Louisiana and will prevent overwash of fronts, tropical storms, and Category I hurricanes (Boyd and Penland 1981).

At the Caminada-Moreau Headland, the historic configuration would be to restore the dunes to the 2.7 m height, while constructing a protective beach and marsh platforms. The headland, under the historic option, would restore more acreage to higher elevations when compared to the pre-Hurricane Andrew option.



4.0. EVALUATION OF STRATEGIC OPTIONS

In this section the strategic options are *qualitatively* evaluated with respect to the resources that are directly or indirectly affected by the continued deterioration of the barrier shoreline along coastal Louisiana. For the purposes of evaluation, the resources are defined into four major categories: Environmental, Social, Economic, and Engineering. Each resource category contains individual evaluation criteria. The barrier shoreline is divided into four sub-areas following the scheme in the USGS *Atlas of shoreline changes in Louisiana from 1853 to 1989* (McBride *et al.* 1992), which enables the qualitative evaluation to be more effective and site-specific. The strategic options are evaluated by forming a series of matrices for each resource category under each sub-area.

4.1. DEFINITION OF THE SUB-AREAS

The Phase 1 Study Area was divided into four sub-areas. Certain areas within the Study Area exhibited unique characteristics (geography, hydrology, proximity to development, etc.) that warranted individual attention in the evaluation process. Dividing the study area into sub-areas allowed the team to identify needs and to ensure a customized evaluation according to individual site characteristics. The sub-areas are shown in Figure 5 and are defined in the following sub-sections.

4.1.1. Sub-Area 1: Isle Dernieres Chain

Sub-Area 1 consists of the Isle Dernieres Island Chain which is 36 km long (22 mi) and extends from Raccoon Point to the Wine Island Shoal. The five islands that make up the present Isle Dernieres chain are: Raccoon Island, Whiskey Island, Trinity Island, East Isle and Wine Island.

4.1.2. Sub-Area 2: Timbalier Chain

Sub-Area 2 consists of the Timbalier Island chain which is essentially the western part of the Bayou Lafourche Barrier System, and extends from Cat Island Pass to Belle Pass. The Timbalier Island chain consists of two islands: Timbalier and East Timbalier.

4.1.3. Sub-Area 3: Caminada-Moreau Headland

Sub-Area 3 consists of the eastern part of the Bayou Lafourche Barrier System and extends from Belle Pass to Barataria Pass. Sub-Area 3 includes: Caminada-Moreau Headland and Grand Isle.

4.1.4. Sub-Area 4: Plaquemines Shoreline

Sub-Area 4 is approximately 48 km long (30 mi) and extends from Grand Terre to Sandy Point. The Plaquemines Shoreline consists of: Grand Terre, Chenier Ronquille, Bay La Mer, Bay Joe Wise Spit, Bastian Island, Shell Island, Pecan Island, and Sandy Point.



4.2. DEFINITION OF RESOURCES AND EVALUATION CRITERIA

Significant resources in the Study Area have been identified and inventoried in the previous steps of this study (Steps E and F). For the evaluation of the strategic options, the resources are summarized into the following four categories. Those key resources which are used as criteria for evaluation are identified in each category. These evaluation criteria are based on the problems, needs, and opportunities identified in Section 2.

- **Environmental** - The evaluation criteria selected under this category include wetlands protection, restoration and creation; landloss prevention; protection and enhancement of flora and fauna, especially threatened and endangered species; and protection, restoration, and creation of barrier island habitat.
- **Social** - The evaluation criteria under this category include population characteristics and demographic patterns, health and safety, jobs and employment, and recreational opportunities.
- **Economic** - The evaluation criteria under this category include residential, commercial, and industrial structures; port facilities; farmland and agricultural resources; public resources; parks and recreational facilities; and archeological sites.
- **Engineering** - The evaluation criteria under this category include longevity of restoration efforts; facility relocation, real estate and right-of-way acquisition; compatibility of restoration efforts with hurricane protection and freshwater diversions in the basin; and estimated cost.

4.3. EVALUATION METHODOLOGY

The evaluation methodology relied on *qualitative* assessments made by professionals with personal knowledge of the study area. The use of qualitative analysis at this stage was directed in the Request for Proposals. This evaluation was considered to be the first level of analysis, producing one or more strategic options to be analyzed in greater detail in later steps of this Study. The following ranking system was used for the evaluation:

- | | | |
|-----|-----------|-----------------|
| (1) | HP | High Positive |
| (2) | MP | Medium Positive |
| (3) | NE | No Effect |
| (4) | MN | Medium Negative |
| (5) | HN | High Negative |

This ranking system is not numerically based and is not meant to provide any quantification of benefits. Two alternatives could receive identical evaluations. The rankings were not mutually exclusive.

During the evaluation the team was divided into four groups according to their areas of expertise (engineering, environmental, social, and economic). Each group developed its evaluation criteria based on the problems, needs, and opportunities described in Section 2 and developed a matrix for each of the sub-areas. This method allowed evaluation of each strategic option along each evaluation criteria in each sub-area.

Eventually, the four groups met to evaluate the options collectively. The team used an interactive group dynamic which relied on personal knowledge of the study area and resource assessments completed in previous steps. Each group completed a matrix for each sub-area according to the evaluation criteria for each strategic option. The strategic options were evaluated compared to future without-project conditions. Once the matrices were completed, each group recommended two options for each sub-area.

Sections 4.4 thru 4.7 contain narrative descriptions of each resource group's evaluation. The matrices are also included.

4.4. EVALUATION OF ENVIRONMENTAL RESOURCES

Table 1 shows the qualitative evaluation of the environmental resources within the four sub-areas. The evaluation is based on the following considerations:

- (1) The assessment of the environmental resources includes the "Zone of Environmental Analysis" and is divided into four shoreline specific sub-areas.
- (2) Benefits to all environmental resources are based on habitat.
- (3) The analysis did not focus on one specific commercial, recreational, or threatened and endangered species.

The no action option is compared to preset conditions in this section to facilitate the reader's understanding of its impacts. The no action option is used as the baseline against which the other options are compared in the following sections. The matrix that follows reflect this, and since the no action option is the baseline, the comparison of no action to itself produces no evaluation.

The following section provides a general discussion supporting the evaluation.

4.4.1. No Action

The no action option is projected to have highly negative environmentally impacts compared to present conditions. The results of the Step G report predict that wetlands/land loss will continue in the future. If barrier islands are allowed to deteriorate they will provide no protection to the remaining wetlands located in the Phase 1 Study Area. Aside from the barrier islands, the no action option would do nothing to prevent other forms of land loss in the coastal region. Loss of the barrier islands may even

accelerate land loss if mechanical erosion due to offshore waves increases as the islands deteriorate. If historical trends continue into the future, the no action option will have negative impacts on both aquatic and terrestrial flora and fauna. Terrestrial flora and fauna are directly impacted by continued land loss. Aquatic fauna may have more habitat as a result of no action, but many of these species use wetlands and barrier islands as nursery areas. Therefore, the long term impacts of no action are highly negative with no action. Certain threatened and endangered species of birds use the barrier islands directly as a stopover point or as nesting grounds. No action would have direct adverse impacts on these species. Not only will the loss of barrier islands have an indirect impact on wetlands habitat within the bays, but on habitat located directly on the islands as well. These unique habitats are predicted to be lost in the future (See the Step G report) as the barrier islands continue to deteriorate.

4.4.2. Strategic Retreat

For the environmental resources evaluation, the strategic retreat option is functionally equivalent to the no action option. All evaluation criteria were rated as no-effect throughout all sub-areas since the impacts would be the same as for "no action."

4.4.3. Fall-Back Option

In the Isles Dernieres sub-area, the fall-back option is rated medium positive for wetlands protection, restoration, creation and land loss. The fall-back option protects the inland bays from waves propagating across the bays. Impacts on flora in the interior bays are medium positive due to the protection provided by building the fall-back barriers. Impacts on fauna are medium positive throughout the Isles Dernieres. The fall-back option foregoes restoring or maintaining any habitat between the existing islands; however, a new line of barriers is created. Building new barriers will increase sheltered bay habitat in the inland portions of the bays, thus having a medium positive impact. Barrier island habitat for threatened and endangered species, as well as other species, results in a medium positive rating for implementing the fall-back option in the Isles Dernieres sub-area. Positive benefits are provided by building new artificial islands, although there is no guarantee that the new islands would be utilized by threatened and endangered species.

In the Timbalier sub-area, the fall-back option is ranked identical to the Isles Dernieres sub-area for the same reasons. Benefits to the bay shoreline are provided by the increased protection of the fall-back barriers. As with no action, areas in the lower reaches of the estuary would remain susceptible to coastal erosion. Building artificial island habitats is a medium positive benefits, but there are concerns as to whether fish, birds, and other species would use these islands.

In the Caminada-Moreau Headland/Grand Isle sub-area, the fall-back option was rated highly positive for all evaluation criteria. By definition (Section 3.0), the Caminada-Moreau Headland/Grand Isle fall-back option is functionally the same as preserving the pre-Hurricane Andrew configuration, except for islands being built in Barataria Bay. By maintaining a fall-back line, wetland protection is provided and future land loss due to coastal erosion may be reduced compared to no action. This option has positive benefits to flora and fauna by providing barrier shoreline protection to inland areas and protecting habitats.

Threatened and endangered species would benefit from the fall-back option by sustaining beach habitat and building new island habitat in Barataria Bay. Also, maintaining the fall-back line continues to provide habitat to all other species directly dependent on these areas.

In the Plaquemines sub-area, the fall-back option was rated as medium positive for all evaluation criteria. The fall-back option protects inland wetlands from wave energy. Land loss prevention would again be provided to areas north of the option as areas south of the new islands are allowed to erode as predicted in the no action option. All flora and fauna in this area would be adversely impacted. Threatened and endangered species would benefit if the fall-back barriers were to serve as the new barrier shoreline. The construction of inland barriers in the Plaquemines shoreline would serve as artificial barriers north of the present shoreline. Those species that currently use the existing shoreline would have to adapt to the new fall-back islands.

4.4.4. Preserve Pre-Hurricane Andrew Configuration

Preserving the pre-Hurricane Andrew configuration rated highly positive for all evaluation criteria in all sub-areas. The preserving the pre-Hurricane Andrew option will protect wetlands by rebuilding and maintaining a more durable barrier shoreline. The strengthened and maintained shoreline would provide sheltering effects from waves and storm surge to help prevent erosion due to average and storm waves. Flora and fauna will be positively impacted with this option by maintaining the natural coastal barrier at the entrance to the estuary. Preserving pre-Hurricane Andrew configuration will protect, restore, and create barrier island habitat for species, including threatened and endangered on the existing islands. The bays in the Phase 1 Study Area have had a barrier shoreline to protect the bays throughout the delta abandonment process.

4.4.5. Historic Configuration

The historic configuration is rated high positive for all evaluation criteria in all sub-areas. The historic configuration and preserving the pre-Hurricane Andrew configuration are similar in their locations and in the benefits provided. The historic configuration is more expansive and the benefits, more pronounced and systemic; therefore, this option is more beneficial than any other. The historic configuration would provide significant protection to bay shorelines from wave energy and storm surge. Protection of the wetlands and reduction of waves could provide long-reaching benefits for land loss prevention. Benefits to flora and fauna along the bays may result as habitats are protected by rebuilding the islands to this magnitude. The historic configuration is the most extensive of the barrier island options, therefore it provides the most barrier island habitat. Threatened and endangered species will benefit by protecting and restoring habitats crucial to their existence. Overall, the historic configuration provides a major barrier that will reduce wave energy and storm surge.

TABLE 1 - ENVIRONMENTAL RESOURCES
Preliminary Evaluation of the Strategic Options

Sub-Area	Evaluation Criteria	Strategic Options				
		No Action	Strategic Retreat	Fall-Back Option	Pre-Hurricane Andrew Configuration	Historic Configuration
Isle Dernieres Island Chain	Wetlands Protection, Restoration, and Creation	-	NE	MP	HP	HP
	Land Loss Prevention	-	NE	MP	HP	HP
	Impact on Flora (Terrestrial and Aquatic)	-	NE	MP	HP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	-	NE	MP	HP	HP
	Impact on Threatened and Endangered Species	-	NE	MP	HP	HP
	Barrier Island Habitat Protection, Restoration, and Creation	-	NE	MP	HP	HP
Timbalier Island Chain	Wetlands protection, restoration, and creation	-	NE	MP	HP	HP
	Land loss prevention	-	NE	MP	HP	HP
	Impact on Flora (Terrestrial and aquatic)	-	NE	MP	HP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	-	NE	MP	HP	HP
	Impact on Threatened and endangered species	-	NE	MP	HP	HP
	Barrier Island habitat protection, restoration, and creation	-	NE	MP	HP	HP
Caminada-Moreau Headland	Wetlands protection, restoration, and creation	-	NE	HP	HP	HP
	Land loss prevention	-	NE	HP	HP	HP
	Impact on Flora (Terrestrial and aquatic)	-	NE	HP	HP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	-	NE	HP	HP	HP
	Impact on Threatened and endangered species	-	NE	HP	HP	HP
	Barrier Island habitat protection, restoration, and creation	-	NE	HP	HP	HP
Plaquemines Shoreline	Wetlands protection, restoration, and creation	-	NE	MP	HP	HP
	Land loss prevention	-	NE	MP	HP	HP
	Impact on Flora (Terrestrial and aquatic)	-	NE	MP	HP	HP
	Impact on Fauna (Wildlife, Avian, Nekton, Infauna, Epifauna)	-	NE	MP	HP	HP
	Impact on Threatened and endangered species	-	NE	MP	HP	HP
	Barrier Island habitat protection, restoration, and creation	-	NE	MP	HP	HP

Based on Table 1, the option of preserving the historic configuration has been selected as a very beneficial option for all four sub-areas. Preserving the pre-Hurricane Andrew configuration has also been selected as a beneficial option in the Isles Dernieres, Timbalier, and Plaquemine sub-areas. In the Caminada-Moreau sub-area, the pre-Hurricane Andrew option and the fall-back option had equally positive benefits.

4.5. EVALUATION OF SOCIAL RESOURCES

Table 2 shows the qualitative evaluation of the social resources within the four sub-areas. The evaluation is based on the following considerations:

- (1) The assessment of social resources is more applicable for the "Zone of Economic Analysis". It was not meant to be shoreline specific.
- (2) The analysis, therefore, was performed at a regional level, since population centers are identified in each region.
- (3) The evaluation is based on the resources that are presently existing. It does not consider extrapolation of trends.
- (4) The key process parameters that governed the evaluation are storm surge, flooding, and salinity. Changes in these parameters have been qualitatively assessed based on input from the modelers, and translated into regional impact characteristics.
- (5) Any relocation and/or abandonment of people or infrastructure is largely limited to areas outside the existing hurricane protection levee system.

The no action option is compared to preset conditions in this section to facilitate the reader's understanding of its impacts. The no action option is used as the baseline against which the other options are compared in the following sections. The matrix that follows reflect this, and since the no action option is the baseline, the comparison of no action to itself produces no evaluation.

4.5.1. No Action

The no action option would adversely affect the study area's population characteristics, since no action may require people to move. Therefore, the no action option is highly negative for population characteristics. Under the no action option, demographic patterns are expected to change because of out-migration which is considered an adverse effect and an unfavorable condition. Jobs and employment could be adversely affected by the no action option. Employment opportunities identified with the oil and gas industry, along with ecologically dependent occupations, such as fishing and trapping, are expected to be negatively impacted. No action may adversely impact the region's freshwater supply. Since surface sources are the major reserves of potable water, any increase in salinity as a result of no action would have adverse impacts on these surface sources. Any increases in salinity would have a highly negative impact on health and safety. The no action option offers no improvement in recreational fishing. Eco-tourism would also be negatively impacted if no-action is taken. Archeological sites will be adversely affected under the no action option, since they will no longer be accessible for surface excavation.

4.5.2. Strategic Retreat

The strategic retreat option is functionally similar to the no action option. The primary difference is that strategic retreat is a plan to move in anticipation of future land loss. With strategic retreat, individuals with wetland-oriented jobs or businesses will no longer be close to their job sites. The loss to social resources as a result of a planned strategic retreat is the same as for no action. Since the impacts were the same as no action, the evaluation was no effect.

4.5.3. Fall-Back Option

Under the fall-back option, people and communities outside the protected barrier and levee system would migrate to more protected areas behind the new sets of barriers and existing levees. The fall-back barriers could potentially provide protection to upper portions of the bays from waves and storm surge. Under the fall-back option, there will be no effect on demographic patterns. The fall-back option will offer

no protection to oil and gas infrastructure in the bays, but will provide medium positive benefits to infrastructure located inland. Similarly, any development and infrastructure facilities outside the fall-back position will lack barrier island protection, while those behind the inland barriers would be protected. Overall, the fall-back option would offer medium positive for jobs and employment. Health and safety would not be affected by the fall-back barriers. Saltwater intrusion would not influence due to the close proximity of the islands to the water supplies. The close proximity of the fall-back barriers to the water supplies, coupled with the necessary inlets of the option, could not reduce saltwater intrusion. Implementation of a fall-back line would have medium positive benefits for fisheries and eco-tourism. The fall-back option may have positive impacts on archeological sites if land loss is reduced, allowing surface excavation.

In the Caminada Moreau headland, the fall back line is similar to the Pre-Hurricane Andrew option. In this area, the effects on social resources will be similar to those attributable to that option, as described in the next section.

4.5.4. Preserve Pre-Hurricane Andrew Configuration

Implementation of preserving the pre-Hurricane Andrew configuration is expected to have positive impacts on population and demographic patterns due to potential flood protection, land loss reduction, and increases in commercial and economically significant species. Restoring and maintaining the pre-Hurricane Andrew configuration option is expected to reduce storm surge flooding and the accompanying fear of future land loss. Eliminating this fear and uncertainty will help increase venture capital, bank loans, and other investments. Preserving the pre-Hurricane Andrew configuration option was evaluated as a high positive. If the pre-Hurricane Andrew configuration option is built and maintained, current drinking water problems/issues will not be resolved, but some minor improvements may take place. This was assessed a medium positive for health and safety. Under the pre-Hurricane Andrew configuration option, fisheries will be protected and enhanced. Also, the opportunity to develop and market the region's eco-tourism will be improved. These options remove some of the uncertainty about the landscape's future. Recreational opportunities were rated highly positive for preserving the pre-Hurricane Andrew configuration option.

The pre-Hurricane Andrew option may also have positive benefits to archeological surface site excavations should land loss be reduced.

4.5.5. Historic Configuration

Implementation of the historic configuration will have medium positive effects on the population characteristics or demographic patterns similar to those for preserving the pre-Andrew condition option. Implementing the historic configuration option is expected to significantly reduce the fear of future land loss. Similar to preserving the pre-Hurricane Andrew configuration option, this reduction in fear and uncertainty will help increase venture capital, bank loans, and other investment. If land loss could be reduced, this may limit or reverse out-migration. The historic configuration option was evaluated as a high positive for jobs and employment. Restoring the historic configuration may reduce saltwater intrusion and some of the harmful effects to the drinking water supply, which is a high positive impact. The historic configuration option will protect and enhance fisheries and help develop and market the region's eco-tourism more than any other option. The historic configuration will create more habitat, protect existing land and will, therefore, have a high positive impact on recreational activities. The historic configuration may help reduce land loss, thus providing positive impacts to archeological site excavations.

Table 2 - SOCIAL RESOURCES
Preliminary Evaluation of the Strategic Options

Sub-Area	Evaluation Criteria	Strategic Options				
		No Action	Strategic Retreat	Fall-Back Option	Pre-Hurricane Andrew Configuration	Historic Configuration
Isle Dernieres Island Chain	Impact on Population Characteristics	-	NE	MP	MP	MP
	Impact on Demographic Patterns	-	NE	NE	MP	MP
	Impact on Jobs and Employment	-	NE	MP	HP	HP
	Impact on Health and Safety	-	NE	NE	MP	HP
	Effect on Recreational Opportunities	-	NE	MP	HP	HP
	Effect on Archeological Sites	-	NE	MP	MP	HP
Timbalier Island Chain	Impact on Population Characteristics	-	NE	MP	MP	MP
	Impact on Demographic Patterns	-	NE	NE	MP	MP
	Impact on Jobs and Employment	-	NE	MP	HP	HP
	Impact on Health and Safety	-	NE	NE	MP	HP
	Effect on Recreational Opportunities	-	NE	MP	HP	HP
	Effect on Archeological Sites	-	NE	MP	MP	HP
Caminada-Moreau Headland	Impact on Population Characteristics	-	NE	MP	MP	MP
	Impact on Demographic Patterns	-	NE	MP	MP	MP
	Impact on Jobs and Employment	-	NE	HP	HP	HP
	Impact on Health and Safety	-	NE	MP	MP	HP
	Effect on Recreational Opportunities	-	NE	HP	HP	HP
	Effect on Archeological Sites	-	NE	MP	MP	HP
Plaquemines Shoreline	Impact on Population Characteristics	-	NE	MP	MP	MP
	Impact on Demographic Patterns	-	NE	NE	MP	MP
	Impact on Jobs and Employment	-	NE	MP	HP	HP
	Impact on Health and Safety	-	NE	NE	MP	HP
	Effect on Recreational Opportunities	-	NE	MP	HP	HP
	Effect on Archeological Sites	-	NE	MP	MP	HP

Based on Table 2, the option of preserving the historic configuration has been selected as the most beneficial option for all four sub-areas. Preserving the pre-Hurricane Andrew configuration has also been selected as a beneficial option in the Isles Dernieres, Timbalier, and Plaquemine sub-areas. In the Caminada-Moreau sub-area, the pre-Hurricane Andrew option and the fall-back option had equally positive benefits.

4.6. EVALUATION OF ECONOMIC RESOURCES

Table 3 shows the qualitative evaluation of the economic resources within the four sub-areas. The evaluation is based on the following considerations.

- (1) The assessment of economic resources is more appropriate for the "Zone of Economic Analysis" in its entirety. It was not meant to be shoreline specific.
- (2) In some cases, the analysis is point specific; some are regional specific.
- (3) The evaluation is based on the resources that are presently existing. It does not consider extrapolation of trends and future developments.
- (4) The key process parameters that governed the evaluation are storm surge, flooding, and salinity. Changes in these parameters have been qualitatively assessed based on input from the modelers, and translated into regional impact characteristics.
- (5) Any relocation and/or abandonment of people or infrastructure is largely limited to areas outside the existing hurricane protection levee system.

The no action option is compared to preset conditions in this section to facilitate the reader's understanding of its impacts. The no action option is used as the baseline against which the other options are compared in the following sections. The matrix that follows reflect this, and since the no action option is the baseline, the comparison of no action to itself produces no evaluation.

4.6.1. No action

The no action option will severely impact residential, commercial, and industrial structures which will be exposed to open Gulf conditions and suffer direct loss. Adopting this option will also affect the costs associated with future construction which will be significantly more expensive. Moreover, no action conditions will result in the loss of pipeline anchor points located on the barrier islands. Pump stations and gas processing plants will be at higher risk without the protection of the barrier shoreline. Port facilities and ancillary services will also be severely affected under the no-action option.

Farmland and agricultural resources are adversely impacted under the no action option as land continues to be lost and the shoreline migrates landward. The potential loss of cattle grazing land and alligator farming caused by shoreline migration is a potential threat to the industry.

Public resources such as schools, roads, bridges, airports/heliports, wetland conservation projects, coastal restoration projects and public water supply facilities will be severely affected under the no action option. Thus the no action option was classified as high negative for this criteria. Under the no action option, flood and hurricane protection projects become severely stressed. Railroads and strategic petroleum reserves will remain unaffected. The impact on park and recreational facilities will be highly negative.

4.6.2. Strategic Retreat

Strategic retreat may be considered as functionally equivalent to no action for economic resources. For this reason the evaluation is no effect.

4.6.3. Fall-Back Option

Oil and gas facilities which are located north of the fall-back option will be positively impacted under the fall-back option. Residential and commercial structures, which are mostly north of the fall-

back option, will remain protected and will have a positive effect. Industrial structures related to the oil and gas industry that are located inside the fall-back option will be positively impacted. The fall-back option will provide storm surge and wave protection to many port facilities, especially Port Fourchon. Farmland and agricultural resources may be slightly improved under this option if land loss is reduced. The fall-back option provides positive effects on public resources, since most of these resources are within the fall-back option. Parks and recreational facilities which are mostly north of the fall-back position will also be positively affected.

In the Caminada Moreau headland, the fall back line is similar to the Pre-Hurricane Andrew option. In this area, the effects on economic resources will be similar to those attributable to that option, as described in the next section.

4.6.4. Preserve Pre-Hurricane Andrew Configuration

Maintaining the pre-Hurricane Andrew configuration will provide protection to existing residential and commercial structures from storm surge and flooding. The vulnerability of industrial structures and complexes in the bays will be reduced under this option. Pipeline anchor points will be established. Evaluation of this option is thus a high positive. The port facilities will be protected from storm surge and waves. Agricultural resources may improve under this option if land loss is reduced.

Maintaining the pre-Hurricane Andrew configuration increases storm surge and flooding protection and is assessed as highly positive. Park and recreational facilities will be positively impacted under this option because of continued protection.

4.6.5. Historic Configuration

The historic configuration will result in a higher degree of protection from storm surge and flooding to residential, commercial, and industrial structures. Furthermore, decreasing the width of the passes will result in calmer conditions in the bays and will improve regional navigability. Pipeline

anchor points will also be secured under this option. The added protection may initiate further residential, commercial and industrial developments and higher investments. Hence, this option is rated highly positive for residential, commercial, and industrial structures.

Restoring the historic configuration will improve storm surge and flooding protection and will provide added protection to port facilities. Human health and safety issues will be abated and should help initiate future expansion, which represents a high positive.

The historic configuration will also have positive impact on farmland and agricultural resources due to reduction in land loss. This is important to the region's economic survival and hence, is rated as high positive. Under this option, fast lands, as well as freshwater marsh, erosion could be reduced resulting in a positive impact on cattle grazing and alligator farming.

The historic configuration will provide added protection to public resources by potentially reducing storm surge flooding and is ranked as highly positive. Recreational facilities will also be positively impacted under this option.

TABLE 3 - ECONOMIC RESOURCES
Preliminary Evaluation of the Strategic Options

Sub-Area	Evaluation Criteria	Strategic Options				
		No Action	Strategic Retreat	Fall-Back Option	Pre-Hurricane Andrew Configuration	Historic Configuration
Isle Dernieres Island Chain	Impact on Residential Structures	-	NE	MP	HP	HP
	Impact on Commercial Structures	-	NE	MP	HP	HP
	Impact on Industrial Structures	-	NE	MP	HP	HP
	Impact on Port Facilities	-	NE	MP	HP	HP
	Impact on Farmland and Agricultural Resources	-	NE	MP	HP	HP
	Impact on Public Resources	-	NE	MP	HP	HP
	Impact on Parks and Recreational Facilities	-	NE	MP	HP	HP
Timbalier Island Chain	Impact on Residential Structures	-	NE	MP	HP	HP
	Impact on Commercial Structures	-	NE	MP	HP	HP
	Impact on Industrial Structures	-	NE	MP	HP	HP
	Impact on Port Facilities	-	NE	MP	HP	HP
	Impact on Farmland and Agricultural Resources	-	NE	MP	HP	HP
	Impact on Public Resources	-	NE	MP	HP	HP
	Impact on Parks and Recreational Facilities	-	NE	MP	HP	HP
Caminada-Moreau Headland	Impact on Residential Structures	-	NE	HP	HP	HP
	Impact on Commercial Structures	-	NE	HP	HP	HP
	Impact on Industrial Structures	-	NE	HP	HP	HP
	Impact on Port Facilities	-	NE	HP	HP	HP
	Impact on Farmland and Agricultural Resources	-	NE	HP	HP	HP
	Impact on Public Resources	-	NE	HP	HP	HP
	Impact on Parks and Recreational Facilities	-	NE	HP	HP	HP
Plaquemines Shoreline	Impact on Residential Structures	-	NE	MP	HP	HP
	Impact on Commercial Structures	-	NE	MP	HP	HP
	Impact on Industrial Structures	-	NE	MP	HP	HP
	Impact on Port Facilities	-	NE	MP	HP	HP
	Impact on Farmland and Agricultural Resources	-	NE	MP	HP	HP
	Impact on Public Resources	-	NE	MP	HP	HP
	Impact on Parks and Recreational Facilities	-	NE	MP	HP	HP

Based on Table 3, the option of preserving the historic configuration has been selected as a favorable option for all four sub-areas. Preserving the pre-Hurricane Andrew configuration has also been selected as a beneficial option in the Isles Dernieres, Timbalier, and Plaquemine sub-areas. In the Caminada-Moreau sub-area, the pre-Hurricane Andrew option and the fall-back option had equally positive benefits.

4.7. EVALUATION OF ENGINEERING PARAMETERS

Table 4 shows the qualitative evaluation of the engineering parameters within the four sub-areas. The evaluation is based on the following considerations:

- (1) Island longevity is defined as the capacity for an option to maintain its configuration based on such physical attributes as added width and height, breach closure, and added sediment to the barrier system.
- (2) Right-of-way acquisitions are the responsibility of the federal, state, or local entity.
- (3) Present-day hurricane protection systems are assumed to be in place.
- (4) Compatibility with river diversions is not based on specific sites; rather, the evaluation was based on proximity to potential diversions of the river.
- (5) Project cost was not a criteria used in the evaluation of strategic options. Preliminary design will be completed in future steps and will contain preliminary costs and quantities.

The no action option is compared to preset conditions in this section to facilitate the reader's understanding of its impacts. The no action option is used as the baseline against which the other options are compared in the following sections. The matrix that follows reflect this, and since the no action option is the baseline, the comparison of no action to itself produces no evaluation.

4.7.1. No Action

The no action option is considered highly negative in the Isles Dernieres sub-area for longevity. No action allows continued deterioration of the barrier shoreline into the future as predicted in the Step G report. As the islands become smaller and more fragmented, erosive processes are likely to accelerate the deterioration rate of the islands. The no action option requires no construction, so facility relocation, real estate costs, and acquisition of right-of-ways are not necessary for implementation. Therefore, the no action option was considered a no-effect for this evaluation criteria. The no action option was considered highly negative for compatibility with existing hurricane protection systems and potential freshwater diversions for the Isles Dernieres. Continued deterioration of the barrier shoreline in these areas allows more storm surge and offshore generated waves to travel into upland areas, as shown in the Step G report. The added pressure placed on existing hurricane protection systems as a result of no action increases the likelihood for system failure. The engineering team determined that new wetlands, gained as a result of freshwater diverted into these areas, would lack the protective benefits provided by the barrier shoreline under the no action option.

In the Timbalier sub-area, the same factors that applied for the Isles Dernieres make the no action option high negative for longevity. The same is true for facility relocation, real estate costs, or acquisition of right-of-ways. The no action option was considered a no effect for this evaluation criteria in the Timbalier sub-area. Regarding compatibility with existing hurricane protection systems and potential freshwater diversions, the no action option in the Timbalier sub-area was considered highly negative for the same reasons that applied to the Isles Dernieres sub-area.

The impact of this option on the Caminada-Moreau Headland/Grand Isle is considered medium negative for longevity. Grand Isle is a slowly eroding island that is predicted to exist in another 100 years. The Caminada-Moreau Headland, however, is predicted to continue its trend of rapid erosion. Nevertheless, the headland is predicted to still have a transgressive beach and material can overwash onto the headland. Therefore, a continually eroding barrier shoreline will exist in the future throughout

the Caminada-Moreau Headland/Grand Isle sub-area. The no action option was also given a no effect for facility relocation, real estate costs, and right-of-way acquisitions as was done in the previous sub-areas, with the exception of the Port Fourchon region. The no action option was considered highly negative for compatibility with existing hurricane protection systems and potential freshwater diversions for the Caminada-Moreau Headland/Grand Isle sub-area. The high negative assessment was given for the same reasons as the Isles Dernieres and Timbalier sub-areas.

The no action option is considered highly negative in the Plaquemines sub-area for longevity, using the same rationale as the other sub-areas. The same is true for facility relocation, real estate costs, or acquisition of right-of-ways in the Plaquemines sub-area. In the Plaquemines sub-area, medium negative effects are attributed to the no action option compatibility with hurricane protection systems and freshwater diversions. However, the compatibility with freshwater diversions is not as negative. The close proximity of the Plaquemines shoreline to the Mississippi River reduces the overall negative effect of the no action option in this area for hurricane protection and compatibility with potential freshwater diversions. A freshwater diversion could still be effective without the present shoreline because of the short distance between the Mississippi River and the Gulf of Mexico.

4.7.2. Strategic Retreat

The strategic retreat option is functionally equivalent to no action option for the engineering parameters. Therefore, strategic retreat is given an evaluation of no effect.

4.7.3. Fall-Back Option

The fall-back option was considered highly positive in the Isles Dernieres for longevity. Fall-back islands would be built similar to existing islands, with added dunes to prevent frequent overwash. The fall-back barriers would be located in lower energy conditions which would increase their longevity. Constructing the fall-back option will create a need to relocate certain facilities that currently lie in the proposed project area. Also, the Federal, State, or local agency sponsoring the

project would have to obtain right-of-ways and purchase certain areas along the project site. Oyster leases located within the fall-back construction area pose a medium negative impact. The fall-back option in the Isles Dernieres was considered highly positive for compatibility with existing hurricane protection systems and potential freshwater diversions. Building an additional set of islands north of the Isles Dernieres would further enhance the existing hurricane protection systems. The fall-back option consists of building new islands in open water. There is no pre-existing island or shoal for which to build upon. Some material may be available from maintenance dredging, but better quality sand would have to be brought in from other sources. Therefore, the cost of the fall-back barriers is rated highly negative in the Isles Dernieres, Timbalier, and Plaquemine sub-areas. In the Caminada-Moreau sub-area, the cost is evaluated as a medium negative because it will be built upon an existing shoreline which can serve as a foundation for the option.

The fall-back option in the Timbalier sub-area was assessed high positive for longevity, similar to the Isles Dernieres sub-area. The same problems exist in the Timbalier sub-area for facility relocation, real estate costs, right-of-ways, and oyster leases as in the Isles Dernieres area. Therefore, a medium negative was assessed in this area for that criteria. The fall-back option was considered to have a high positive compatibility with existing hurricane protection systems and potential freshwater diversions. A fall-back barrier in this area would enhance hurricane protection and enhance benefits of a diversion along Bayou Lafourche.

By definition (Section 3.0), the Caminada-Moreau Headland/Grand Isle fall-back option is functionally the same as preserving the pre-Hurricane Andrew configuration, with the exception being islands being built in Barataria Bay. This option adds needed sediment to the system and restores the barrier shoreline to a recent condition. Adding height to low-lying areas will reduce the frequency of overwash, so the longevity of the option is medium positive. Facility relocation, real estate costs, right-of-ways, and oyster leases are medium negative throughout the sub-area. The fall-back option will add

elevation to the beaches and provide a new inland barriers in Barataria Bay to supplement existing hurricane protection systems. Any freshwater diversions in the area will benefit from wave and water level protection provided by the option. The fall-back option was given a high positive rating for compatibility with hurricane protection systems and freshwater diversions.

In the Plaquemines sub-area, the fall-back option was considered highly positive for longevity. The fall-back option would enjoy some protection from the remaining marsh and the present barrier shoreline. The facility relocation, real estate costs, right-of-ways acquisition, and extensive oyster leases will be very difficult for the proposed area and was considered highly negative. The many landowners and oyster leases in this area that will make right-of-way acquisition difficult. Existing pipelines in the area make relocation a major obstacle too. The fall-back option was given a high positive rating for compatibility with hurricane protection systems and freshwater diversions. The fall-back option would aid in hurricane surge reduction and could help retain freshwater in the marshes from a diversion.

4.7.4. Preserving the Pre-Hurricane Andrew Configuration

Preserving the pre-Hurricane Andrew configuration was considered highly positive in the Isles Dernieres sub-area for longevity. The pre-Hurricane Andrew option would rebuild the island with added dunes to prevent frequent overwash and add overall life to the barrier system. Constructing this option will involve minimal effort to relocate facilities, buy real estate, or obtain right-of-ways. Land would be rebuilt in sections adjacent to the pre-existing islands. Therefore, the pre-Hurricane Andrew configuration option was considered medium negative for that evaluation criteria. The pre-Hurricane Andrew configuration option in the Isles Dernieres is considered high positive for compatibility with existing hurricane protection systems and potential freshwater diversions. Rebuilding the islands would provide additional hurricane protection, but would have limited benefits for freshwater diversions in the Isles Dernieres sub-area. The pre-Hurricane Andrew option will have a medium

negative cost in all sub-areas. The project is quite large, but construction will occur upon existing islands and shoals.

The pre-Hurricane Andrew configuration option in the Timbalier sub-area was assessed highly positive for longevity for the same factors as the Isles Dernieres sub-area. Again, problems concerning facility relocation, real estate costs, and right-of-ways are minimal for similar reasons as in the Isles Dernieres area. Therefore, a medium negative was assessed in the Timbalier sub-area for that evaluation criteria. This option was given a high positive for compatibility with existing hurricane protection systems and potential freshwater diversions. Restoring the islands to this condition will provide positive storm surge reduction benefits and limited diversion benefits.

As stated in Section 4.7.3, the Caminada-Moreau Headland/Grand Isle fall-back option and the pre-Hurricane Andrew configuration option are the same, except in Barataria Bay where no inland barriers are built for the pre-Hurricane Andrew configuration. This option is evaluated as medium positive for longevity for the same reasons as the fall-back option in the Caminada-Moreau Headland. Also, a medium negative rating was given for this option, due to potential facility relocation, real estate costs, right-of-ways, and oyster leases in this area. A high positive rating was given for compatibility with hurricane protection systems and freshwater diversions. Rebuilding the shoreline will increase storm surge reduction in the area and work beneficially with a diversion. The benefits with a diversion are medium positive.

In the Plaquemines sub-area, the pre-Hurricane Andrew configuration option was evaluated highly positive for longevity. The pre-Hurricane Andrew configuration option adds a significant amount of material back to pre-existing islands. Some problems may exist, to a lesser degree, for the pre-Hurricane Andrew option for facility relocation, real estate costs, right-of-ways acquisition, and oyster leases, thus a medium negative rating was given.. The pre-Hurricane Andrew configuration option was considered highly positive for compatibility with hurricane protection systems and

freshwater diversions. The close proximity to the river would allow the barrier islands in Plaquemines to help protect any wetlands created from a freshwater diversion. Adding this much land back to the barrier islands will serve as a buffer for storm surge.

4.7.5. Historic Configuration

The historic configuration will add maximum longevity to the barrier islands; therefore, a highly positive rating was given for the Isles Dernieres sub-area. Raising the dune height to prevent overwash from tropical storms and small hurricanes will add life to the islands. The added width and length will seal breaches and allow overwash material to deposit, instead of sand being removed from the littoral system. A restoration project of this size will allow the islands to function as a continuous system and allow sand to travel in the system. Building the historic configuration will have some effect on facility relocation, real estate costs, and right-of-ways acquisition, because the project is adjacent to the islands. The historic configuration option will provide highly positive benefits against storm surge, thus working well with existing hurricane systems. Any freshwater added to Terrebonne Bay or Lake Pelto will benefit from the added protection from waves and extreme water levels provided by this option being implemented in the Isles Dernieres sub-area. The historic configuration is a very beneficial option and may perhaps be the most expensive. Rebuilding of barrier islands at this magnitude will require a significant source of funding for initial and maintenance construction. Cost is evaluated as high negative in all sub-areas.

The Timbalier sub-area is rated highly positive for longevity using the same reasons as in the Isles Dernieres sub-area. Again, minimal negative effects are anticipated for facility relocation, real estate costs, acquisition of right-of ways, and oyster leases , since the project is an extension of the existing islands. The Timbalier sub-area will provide the same hurricane and river diversion benefits as

in the Isles Dernieres sub-area. The closure and reduction of inlets throughout the Terrebonne Basin will provide maximum hurricane protection and reduction of ocean waves in the bay.

The historic configuration in the Caminada-Moreau Headland/Grand Isle sub-area was considered highly positive for longevity. A significant amount of sand would be added to the system that would increase the life and integrity of the barrier shoreline in this area. Creating higher dunes will prevent frequent overwash from fronts, tropical storms, and minor hurricanes. The added sediment to the headland could be transported in the longshore current both east and west; supplying sand to both Grand Isle and East Timbalier Island. Building the historic configuration in this area may be difficult due to major facility relocation, real estate costs, and right-of-way acquisitions. There is a significant amount of infrastructure throughout this area that would be directly impacted by constructing a project of this size. Therefore, a medium negative rating was assessed for this evaluation criteria. The historic configuration was rated as highly positive for compatibility with existing hurricane protection systems and potential freshwater diversions. Building the historic configuration option provides a large barrier at the southernmost extent of the study area. The increased width and height of the islands will reduce storm surge, thus reducing the pressure on existing hurricane protection systems. In addition, closing and reducing inlets will reduce the amount of offshore-generated wave energy transmitted into the bays. The reduction in wave energy will provide protection to any land created using freshwater diversions.

In the Plaquemines sub-area, the effectiveness on longevity by using this option was high positive. This is based on the same reasons as for the Caminada-Moreau Headland. Building the historic configuration had a medium negative evaluation for facility relocation, real estate costs, right-of-ways, and oyster leases. The effort is an extension of the existing islands, so a medium negative was assessed for this criteria. Existing hurricane protection systems and potential river diversions would work well with the historic configuration, so a high positive rating was assigned for this criteria. Similar to the other sub-areas, this option provides maximum barrier protection from wave energy and

storm surge. The added protection of the rebuilt barriers provides an extra measure of protection from hurricanes. Meanwhile, the historic configuration option protects existing and newly created wetlands from high energy conditions that cause shoreline erosion.

TABLE 4 - ENGINEERING PARAMETERS
Preliminary Evaluation of the Strategic Options

Sub-Area	Evaluation Criteria	Strategic Options				
		No Action	Strategic Retreat	Fall-Back Option	Pre-Hurricane Andrew Configuration	Historic Configuration
Isle Dernieres Island Chain	Effectiveness in Barrier Island Restoration Longevity	-	NE	HP	HP	HP
	Need for Facility Relocation, Real Estate Cost, Right-of-Way	-	NE	MN	MN	MN
	Compatibility with the Existing and Proposed Hurricane Protection Systems and Freshwater Division Plans in the Study Area	-	NE	HP	HP	HP
	Anticipated Project Cost	-	NE	HN	MN	HN
Timbalier Island Chain	Effectiveness in Barrier Island Restoration Longevity	-	NE	HP	HP	HP
	Need for Facility Relocation, Real Estate Cost, Right-of-Way	-	NE	MN	MN	MN
	Compatibility with the Existing and Proposed Hurricane Protection Systems and Freshwater Division Plans in the Study Area	-	NE	HP	HP	HP
	Anticipated Project Cost	-	NE	HN	MN	HN
Caminada-Moreau Headland	Effectiveness in Barrier Island Restoration Longevity	-	NE	MP	MP	HP
	Need for Facility Relocation, Real Estate Cost, Right-of-Way	-	NE	MN	MN	MN
	Compatibility with the Existing and Proposed Hurricane Protection Systems and Freshwater Division Plans in the Study Area	-	NE	HP	HP	HP
	Anticipated Project Cost	-	NE	MN	MN	HN
Plaquemines Shoreline	Effectiveness in Barrier Island Restoration Longevity	-	NE	HP	HP	HP
	Need for Facility Relocation, Real Estate Cost, Right-of-Way	-	NE	HN	MN	MN
	Compatibility with the Existing and Proposed Hurricane Protection Systems and Freshwater Division Plans in the Study Area	-	NE	MP	HP	HP
	Anticipated Costs	-	NE	HN	MN	HN

Based on Table 4, the option of preserving the historic configuration has been selected as the most beneficial option for all sub-areas. Preserving the pre-Hurricane Andrew configuration has also been selected as a beneficial option in the Isles Dernieres, Timbalier, and Plaquemine sub-areas. In the Caminada-Moreau sub-area, the pre-Hurricane Andrew option and the fall-back option had equally positive benefits.

4.8. SUMMARY OF EVALUATION RESULTS

Following the completion of the individual resource group evaluations, the team met to discuss each group's preferred options and to ultimately recommend options for more detailed analysis. Each resource group presented its evaluation and explained the rationale for their conclusions (Table 5). Other team members questioned the groups and suggested alternative evaluations. This process improved the analysis by forcing team members to substantiate their evaluations in response to criticism.

After each group presented its conclusions, the team combined their evaluations into two study area recommendations. This combination was based on the conclusions from each group equally. The historic configuration and the pre-Hurricane Andrew configuration options were those most preferred by the economic, social, and environmental groups.

In the Isles Dernieres, Timbalier, and Caminada-Moreau Headland/Grande Isle sub-areas, the engineering group considered the fall-back option more appropriate than the pre-Hurricane Andrew configuration. The differences in the engineering evaluation between the fall-back option and the pre-Hurricane Andrew configuration were small. Because the other groups agreed that the pre-Hurricane Andrew configuration should be a recommended option and because there were only marginal differences in the engineering evaluation between the fall-back option and the pre-Hurricane Andrew option, the second overall team option was the pre-Hurricane Andrew option.

Table 5. Summary of Evaluation Results

Resources	Sub-Area							
	Isle Dernieres Sub-area		Timbalier Sub-area		Caminada-Moreau Headland/Grande Isle Sub-area		Plaquemines Sub-area	
	Rank I	Rank II	Rank I	Rank II	Rank I	Rank II	Rank I	Rank II
Environmental	HC	PA	HC	PA	HC	PA/FB	HC	PA
Social	HC	PA	HC	PA	HC	PA/FB	HC	PA
Economic	HC	PA	HC	PA	HC	PA/FB	HC	PA
Engineering	HC	PA	HC	PA	HC	PA/FB	HC	PA

FB - Fall-Back Option

PA - Pre-Hurricane Andrew Configuration

HC - Historic Configuration

5.0. FORMULATION OF MANAGEMENT ALTERNATIVES

In combining the sub-area recommendations into the overall Study Area recommendations, the team considered the systemic effects of implementing the options. During this evaluation, the team realized that there were nuances in the sub-areas not recognized in these broad options. The team realized that the broad options outlined in the Request for Proposals did not completely meet the individual needs of all the sub-areas and that these needs could be addressed by modifications to the strategic options. In some areas, combinations of options were necessary to maximize the benefits. While in other areas, the marginal benefits of the most favorable option were minimal when compared to the second option. The team utilized the completed evaluation and the expertise developed from the evaluation to modify the selected options.

5.1. EVALUATION OF THE PREFERRED OPTIONS

The preliminary evaluation of the strategic options leads to the two most preferred options at the sub-area level: (1) Preserving the Historic Configuration, and (2) Preserving the Pre-Hurricane Andrew Configuration of the Barrier Shoreline. These two options were then further evaluated at a second level of analysis for their applicability at the basin-wide level.

Restoring and maintaining the historic configuration at a basin-wide level best corresponds with our evaluation criteria. The historic configuration of the shoreline will combat storm surge and hurricane waves, and will help reduce coastal erosion. The oil and gas industry will benefit from protection from wave energies. This will contribute to the area's economy. This option will also protect and promote the social and cultural diversity of coastal Louisiana. Implementation of this option will thus contribute significantly to the existing resources of coastal Louisiana.

Preserving the historic configuration still allows locally generated waves to impact the fringing marsh along the bay shoreline. In the Caminada-Moreau Headland/Grande Isle sub-area, preserving the historic configuration will not provide enough additional benefits, as opposed to preserving the pre-Hurricane Andrew configuration, to justify what may be a significant difference in cost of implementation of these two options. These considerations lead to a conclusion that implementing a combination of several options would be a better alternative than to preserve the historic configuration over the entire basin.

Similar analysis is applicable to the preserving the pre-Hurricane Andrew option. This configuration contains several inlets which disrupt the littoral transport in the system. These inlets act as sediment sinks by removing sediment from the littoral system. The inlets also allow ocean generated waves to propagate into the bays.

These circumstances emphasized the need to further evaluate and refine both options. The following sections contain a description of these refined management alternatives and the rationale the team used in developing them.

5.2. DEVELOPMENT OF ALTERNATIVES

After discussing the deficiencies in the basin wide options, the team began manipulating the options to address those deficiencies. The team had these objectives:

- Reduce storm surge and wave energy in the bays
- Enhancing recreational and commercial resources
- Maximize protection of land and habitat in the bays
- Providing a more continuous island chain to maintain sediment supplies

The following sections contain the two management alternatives which resulted from this process. These two management alternatives are recommended for further analysis in the remaining steps of the study.

5.2.1 Alternative 1

The first alternative is a combination of options (Figure 6). The Isle Dernieres, Timbalier Islands, and the Plaquemines shoreline are restored and maintained to the historic configuration. The Caminada-Moreau Headland and Grand Isle are restored and maintained to the pre-Hurricane Andrew configuration. In addition, wave barriers are placed in the fringing marshes to reduce fetch and protect inland marsh from locally generated waves. A detailed description of this alternative is as follows.

Beginning in the western portion of the study area, wave barriers will be used along the fringing marsh at Caillou Bay. The wave barriers begin near the Bayou Grand Caillou outlet and continue parallel with the marsh shoreline. They end at the fringing marsh due north of Whiskey Island's western end. The wave absorbers begin again in Terrebonne Bay north of the eastern spit at East Isle in Bay St. Elaine's northern edge. The inland barriers extend along the southern portions of Lake Barre and Lake Raccourci and end at Pierle Bay. The wave barriers function similar to the fall-back option, but would be constructed of rock, shell, or other material.

By restoring the Isle Dernieres chain, a continuous barrier would maximize the benefits to all coastal resources in Lake Pelto. Construction of the project would have public support and landright ownership issues would be negotiated by the State of Louisiana. The inland barriers will buffer storm surge and wave energy transmitted around the continuous island chain and protect inland marshes. By reducing the number of inlets, and increasing island width and dune height, the erosion rate of the islands will likely decrease as more material remains in the system. Restoration and maintenance of the continuous island will counteract some of the sediment deficiency found throughout the area and allow sediment to travel along a continual shoreline.

The Timbalier Islands will be connected to the Bayou Lafourche Headland, with the exception of leaving Little Pass open. The same storm surge and wave dampening effects exist for these islands as do the Isle Dernieres. Little Pass would remain as a navigation access inlet for recreational and commercial vessels. Raising the dune heights and rebuilding the islands will provide non-fragmented barriers that can continue to migrate and protect coastal resources. The inland barriers will reduce fetch in Terrebonne and Barataria Bays and absorb locally- and offshore-produced waves. The interior barriers and the restored island will also offer noticeable protection for other coastal restoration measures (e.g., diversions).

The Caminada-Moreau Headland and Grand Isle will be preserved to the pre-Hurricane Andrew configuration. These areas house and protect many economic and social resources. The Caminada-Moreau Headland is the fastest eroding shoreline in Louisiana. Preserving the pre-Hurricane Andrew beach will be a significant task that will require higher maintenance than other areas. If the beach is maintained and the dunes are raised, the resources on the headland will be protected. The sediment being eroded will provide sand to Grand Isle and the Timbalier Islands. Grand Isle is the most stable barrier island in the study area. As shown in Step G, Grand Isle remains as a large island in 100 years. Restoring to a historic configuration will therefore be unnecessary. Therefore, by maintaining the pre-Hurricane Andrew configuration of Grand Isle, the coastal resources will be protected.

The Plaquemines shoreline will be restored to the historic configuration. This will provide a non-fragmented chain of barrier islands and reduce surge and wave propagation to the hurricane protection levees. In addition, these islands will provide significant protection for potential marsh creation near the Mississippi River. Wave barriers will be placed along the northern marshes in Barataria Bay from Pelican Point to the northwest edge of Lake Grande Ecaille. The wave barriers will absorb wave energy in Barataria Bay.

**BARRIER ISLAND PLAN
MANAGEMENT ALTERNATIVE #1**

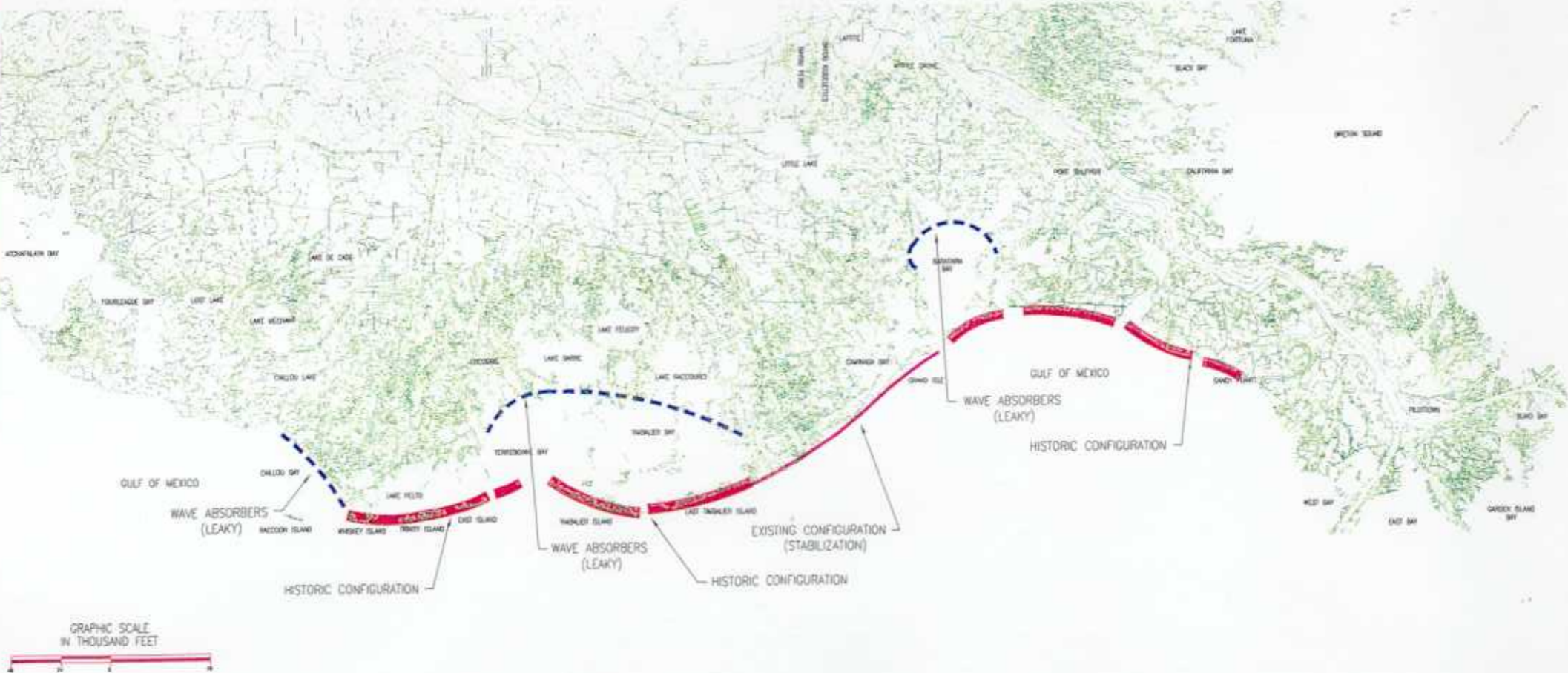


FIGURE 6

5.2.2. Alternative 2

The second alternative is a smaller plan, with less cost and resource benefits in comparison to Alternative 1. Alternative 2 provides benefits to the coastal resources, as evaluated by the team, but the magnitude of the alternative was minimized in order to compare cost and benefits at a smaller scale. The team recognized that the benefits accrued from Alternative 2 are less than those for Alternative 1. This plan restores and maintains the islands to their pre-Hurricane Andrew configuration in all sub-areas with added modifications as mentioned in the following paragraph (Figure 7). Land is restored in its present location, which provides protection to bay infrastructure and sustains terrestrial habitat at the outer edge of the estuary. The islands remain in a sediment deficient state, with most of the pre-Hurricane Andrew inlets remaining open. Dune heights are raised to prevent frequent overwash and add stability to the islands. No inland wave barriers are included in this alternative.

The additional modification in this alternative includes restoration of Raccoon Island and closing Coupe Colin and New Cut at the Isle Dernieres. Whiskey Pass and Wine Island Pass are the only two passes left open in the Isle Dernieres. The closing of Coupe Colin and New Cut will not present a significant navigational problem, as these inlets are relatively shallow and are not maintained. By closing the inlets, sediment will not be lost from the littoral system, thus reducing erosion rates and maintenance costs. Closing the inlets will also increase the benefits afforded to the socio-economic and environmental resources by having a more continuous island barrier. This alternative also includes the closing of Raccoon Pass which is located between East Timbalier Island and the Caminada-Moreau Headland. This is also not a major navigational pass, but does have the adverse function of removing sediment from the system. Closing Raccoon Pass will allow more material to travel uninterrupted in the littoral system.

BARRIER ISLAND PLAN MANAGEMENT ALTERNATIVE #2



FIGURE 7

6.0 SUMMARY

The purpose of Step I was to define and *qualitatively* evaluate the strategic options contained in the Barrier Shoreline Feasibility Study Request for Proposals. To complete the step, the TBS team first defined the strategic options, identified problems, needs, and opportunities in the study area, developed evaluation criteria, and ranked the options according to the evaluation criteria. After identifying the two given strategic options which provided the most benefits, the team customized these options to address perceived deficiencies in the original options. These customized options were then recommended for further study in later steps.

The strategic options outlined in the Request for Proposals were not adequately defined to facilitate analysis in Step I. To qualitatively evaluate the options, the team needed a better understanding of each option, including a narrative description of island lengths and widths and a map indicating the locations of the options. These option characteristics were developed by the team in consultation with Federal and State resource agencies.

The team then identified the problems, needs, and opportunities associated with barrier shorelines in the Phase 1 Study Area. The team identified problems and needs associated with barrier shoreline erosion in the present and future. The team then developed opportunities that reflect the desired effects on Louisiana's coastal resources resulting from barrier island restoration. The problems, needs, and opportunities identified by the team were later used by the resource groups in the evaluation phase of this step.

The team then developed criteria to evaluate the strategic options. The Request for Proposals directed the team to evaluate the options according to four resource groups: economic, social, engineering, and environmental. In each of these groups, team members developed specific criteria to evaluate the options. These criteria were based on the problems, needs, and opportunities identified earlier.

The team then divided the study area into sub-areas based on similar geographic or geologic conditions. This subdivision allowed the team to consider the unique circumstances of each sub-area when conducting the evaluations.

To evaluate the options, the team used a *qualitative* system based on the personal knowledge of team members and the resource assessments and modeling efforts conducted prior to this step. The team did not quantify the benefits of each option. The evaluation is based on a scale reflecting the positive or negative effects of each of the options on the resources. The evaluations were not mutually exclusive; two options could have the same evaluations regarding the same criteria.

The evaluation of options was completed in two steps. First, team members met in the resource groups according to their expertise. The resource groups completed matrices for each of the options in each sub-area. The team then met as a whole and each group presented its results. The team discussed each group's evaluation and critiqued the conclusions. Following this discussion, the team combined the individual group evaluations into overall team evaluations. The evaluation indicated that two strategic options, the historic configuration and preserving the pre-Hurricane Andrew configuration, would provide the most benefits.

After completing the evaluation, the team realized that the given strategic options contained deficiencies. The team decided, based on the expertise gained through the previous steps and the recently completed evaluation, that the two identified strategic options could be improved. The team customized the historic configuration option by adding wave barriers in the larger bays. The team also reduced the scope of the option by only recommending preserving the pre-Hurricane Andrew configuration in some areas where restoring to the historic configuration would only have marginally increased the benefits. The team customized the pre-Hurricane Andrew configuration option by closing some inlets that would otherwise have remained open. By closing the inlets, the team felt the option would be more durable and would therefore provide more benefits.

These two options were then recommended for further analysis. In Step J, the team will numerically model the physical and hydrological impacts of the two alternatives. From this analysis, the environmental, economic, and social benefits will be quantified. In Step K, the team will complete a preliminary design of the two alternatives. The cost associated with implementing and maintaining the alternatives will be quantified. The design will also include an evaluation for using combinations of soft and hard structures to maximize benefits and reduce costs.

7.0 REFERENCES

- Boyd, R. and S. Penland. 1981. Washover of deltaic barriers on the Louisiana coast. *Transactions of the Gulf Coast Association of Geological Societies*, 31:243-248.
- Leatherman, S.P. 1981. *Overwash Processes*. Benchmark Papers in Geology, Volume 58, Hutchinson Ross Publishing Co., Stroudsburg, PA, 377 p.
- Louisiana Coastal Wetlands Conservation and Restoration Task Force. 1993. *Louisiana Coastal Wetlands Restoration Plan - Main Report and Environmental Impact Statement*.
- McBride, R.A. S. Penland, M.W. Hiland, S. J. Williams, K.A. Westphal, B.E. Jaffe and A.H. Sallenger, Jr. 1992. Analysis of barrier shoreline change in Louisiana from 1853 to 1989. pp. 36-97 In Williams, Penland and Sallenger, Jr. (eds.) *Louisiana barrier island erosion study. Atlas of shoreline changes in Louisiana from 1853 to 1989*. Miscellaneous Investigations Series I-2150-A. Washington, D.C.: U.S. Government Printing Office.
- Thompson, B.A. 1988. Fish and Shellfish. in: *Environmental Assessment Isles Dernieres Barrier Island Stabilization Project*. Plaisance/Smith Engineers, Houma, Louisiana. p 31.
- U. S. Army Corps. of Engineers 1984. *Coastal Area, LA Initial Evaluation Report on Shore and Barrier Island Erosion*. U. S. Army Corps of Engineers, New Orleans District.